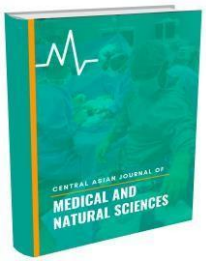

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*Article*

# Predictive Value of Mallampati Score and Thyromental Distance for Difficult Intubation in Obese Patient

**Ammar Hamid Hamad[1], Hesham Ahmed Talab[2], Huda Mohammad Eskender[3]**

1, 2, 3. Al-Mashreq University, Baghdad- Iraq
* Correspondence: ammarhamed200880@gmail.com, Heshamahmed40098@yahoo.com

**Abstract:** The task of ensuring control of the airway in obese patients is found to be more challenging because it increases the possibility of facing difficulties during intubation, thereby increasing anesthesia-related complications in obese patients. The study aims to determine how Mallampati scores and thyromental distance measurements were predictive of difficult intubation outcomes in obese patients using their Cormack-Lehane classification outcomes. To carry out this study, a prospective cohort study design was done on 60 obese participants with a BMI of 30 kg/m² and above, aged between 18 and 45 years, in Al-Imamin Al-Kazemin Medical City from January to October 2023. Patients were not included in the study if they had abnormal airways, severe respiratory disease, critical illness, or trauma. Data were collected through demographic data, medical history, Mallampati scores, thyromental distance, Cormack-Lehane grade measurement, and intubation attempts and device usage. The research results showed that patients with higher Mallampati scores and shorter thyromental distances experienced more difficult intubation results which required multiple intubation attempts and resulted in greater use of adjunct devices like stylets and bougies. The research shows that using Mallampati score and thyromental distance together with Cormack-Lehane classification system enables better prediction of difficult intubation cases in obese patients which makes preoperative airway management safer and more effective.

**Keywords:** Mallampati score, thyromental distance, Cormack-Lehane classification, difficult intubation, obese patients, airway management

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## Introduction

The anatomical and physiological changes which make difficult intubation more likely in obese patients create major obstacles for airway management. Cormack-Lehane Grade III or IV describes difficult intubation because it prevents doctors from seeing the glottis which leads to higher patient risks during surgery. The presence of fat in the neck pharynx chest and abdomen regions of obese patients results in decreased airway space and chest wall movement and oxygen supply which makes mask ventilation and laryngoscopy and tracheal intubation more difficult [1].

The risk of airway obstruction rises for obese patients because approximately 40% of them develop obstructive sleep apnea (OSAS). The pharyngeal narrowing and elevated extraluminal pressure in obesity create conditions which lead to airway collapse during periods of anesthesia and muscle relaxation. Preoperative screening through the STOP-BANG questionnaire and polysomnography (PSG) enables doctors to identify patients

who require special attention and to create effective treatment plans for their surgical procedures [2].

Doctors use clinical airway assessment tools such as the Mallampati score and thyromental distance to determine which patients will experience difficulties during intubation. The Mallampati score evaluates the visibility of oropharyngeal structures, while thyromental distance measures the anteroposterior space available for laryngoscopy. The combined use of these two measures results in better predictive capacity for obese patients who experience anatomical changes that make airway management more difficult [3].

The study establishes which indicators through Mallampati score and thyromental distance measurement forecast difficult intubation outcomes for obese patients which will create evidence-based methods for preoperative airway evaluation that enhance patient safety through improved anesthesia practicesm [4].

**Table 1.** Han's mask ventilation grading scale.

| Grade | Description |
|---|---|
| Grade 1 | Ventilated by mask |
| Grade 2 | Ventilated by mask plus oral airway adjuvant +/-muscle relaxant |
| Grade 3 | Difficult to mask ventilate despite above, inadequate or unstable, requiring two providers |
| Grade 4 | Unable to mask ventilate with or without the use of muscle relaxants |

**Impossible mask ventilation**

Failure to achieve adequate breathing using a bag-mask despite the efforts of several clinicians, despite the use of airway adjuvants with or without neuromuscular inhibition.

**Table 2.** Predictors of impossible mask ventilation.

| Predictors of Impossible Mask Ventilation |
|---|
| Neck radiation changes |
| Male gender |
| Obstructive sleep apnoea |
| Mallampati 3 or 4 |
| Presence of a bear |

**Difficult Laryngeal Mask Ventilation and Endotracheal Intubation**

The anesthetic procedure faces major difficulties because obese patients encounter greater problems with Laryngeal Mask Airway (LMA) ventilation and endotracheal intubation. The term difficult LMA ventilation describes a situation where medical staff cannot create acceptable ventilation results after trying to insert the device three separate times with tidal volumes above 7 ml/kg and leak pressures between 15 and 20 cm $H_2O$ [5-7]. The risk of LMA failure which requires endotracheal intubation as a replacement method becomes more frequent in patients who have obesity combined with male sex and

poor dental health and who need surgical bed rotation. The difficulty of endotracheal intubation emerges when medical personnel need to spend extended time on intubation while making multiple laryngoscopy attempts and facing limited glottic visibility and multiple attempts to use specialized tools [8]. The main risk factors for the situation involve obesity and limited mouth opening and restricted neck extension and the absence of a trained assistant. The term difficult laryngoscopy applies to situations where medical professionals struggle to see the glottic view although they are able to place tubes successfully. Medical personnel must conduct systematic preoperative airway assessments through the use of Mallampati score and thyromental distance measurements which are necessary for conducting airway assessments in obese patients [9]. The Mallampati classification system evaluates oropharyngeal visibility while measuring thyromental distance calculates the distance between the thyroid notch and the mentum. Higher Mallampati classes and shorter thyromental distances create a greater chance of LMA ventilation difficulties and endotracheal intubation challenges which link to increased Cormack-Lehane grades. The LEMON mnemonic (Look-Evaluate-Mallampati-Obstruction-Neck) uses these measurements as essential components to create an organized system that helps doctors determine airway difficulty during emergency situations. The accurate evaluation of Mallampati score and thyromental distance enables anesthesiologists to forecast potential airway challenges which lets them prepare for using additional devices like stylets and bougies while they build plans that minimize LMA ventilation and intubation problems in obese patients [10]. The tools prove highly useful for enhancing airway management which leads to improved safety during operations within this group that faces high risks.

**Table 3.** Murphy and Walls's bedside predictors of difficult intubation with direct laryngoscopy.

| | **Description** |
|---|---|
| L | Look externally |
| E | Evaluation: |
| | - Mouth opening <5cm |
| | - Thyromental distance <6cm |
| M | Mallampati class |
| O | Obstruction |
| N | Neck mobility |

**Failed Intubation and Incidence:**

The medical profession considers multiple attempts at endotracheal tube insertion to be failed intubation when doctors cannot succeed in their attempts. The inability to oxygenate a patient properly creates a situation that can lead to death although oxygen deprivation by itself does not pose immediate danger. Difficult mask ventilation occurs in 1.4–5% of cases, impossible ventilation in 0.16–0.7%, difficult tracheal intubation in 5–8%, and intubation failure in 0.05–0.35%. Video laryngoscopes achieve success rates of 97–99.6%, even in anticipated difficult airways [11]. Anesthetists need to evaluate patients before surgery to determine their airway condition through a preoperative assessment which must deliver quick results while detecting oxygenation risks. Excess pharyngeal fat and limited cervical mobility combined with diabetes and other comorbid conditions create a situation that makes intubation more challenging for obese patients. The factors which predict difficult mask ventilation include age above 55 years body mass index over 26 kg/m² and conditions of edentulism and snoring and presence of a beard and thyromental distance below 6 cm. The decision to use awake intubation for high-risk patients depends on the expertise of the anesthesiologist together with the available medical equipment [12].

**The section below explains the complications which occur during medical procedures and the methods used to handle them.**

Difficult intubation may cause hypoxia, aspiration, esophageal intubation, cardiovascular instability, or death. Airway management requires optimal implementation through ramped or reverse Trendelenburg patient positioning and preoxygenation at $FiO_2$ 1.0 and CPAP use for obese patients and the correct application of airway devices. Healthcare providers should customize rapid sequence induction (RSI) implementation because its standard application for obese patients does not suit all situations [13]. Supraglottic devices like LMA ProSeal and video laryngoscopes (GlideScope, Airtraq) improve airway control and safety. In "cannot intubate/cannot ventilate" situations doctors use surgical cricothyroidotomy as their first rescue method while awake fiberoptic intubation with topical anesthetics stands as a second option [14].

**Mallampati Score:**

The Mallampati classification predicts difficult intubation based on tongue size relative to the oropharyngeal cavity. Modified scoring:

- Class 0: Any part of epiglottis visible
- Class I: Soft palate, uvula, and pillars visible
- Class II: Soft palate and uvula visible
- Class III: Only soft palate and base of uvula visible
- Class IV: Only hard palate visible

The score is obtained with the patient seated, mouth fully open, and tongue protruded. Higher Mallampati classes correlate with increased intubation difficulty.

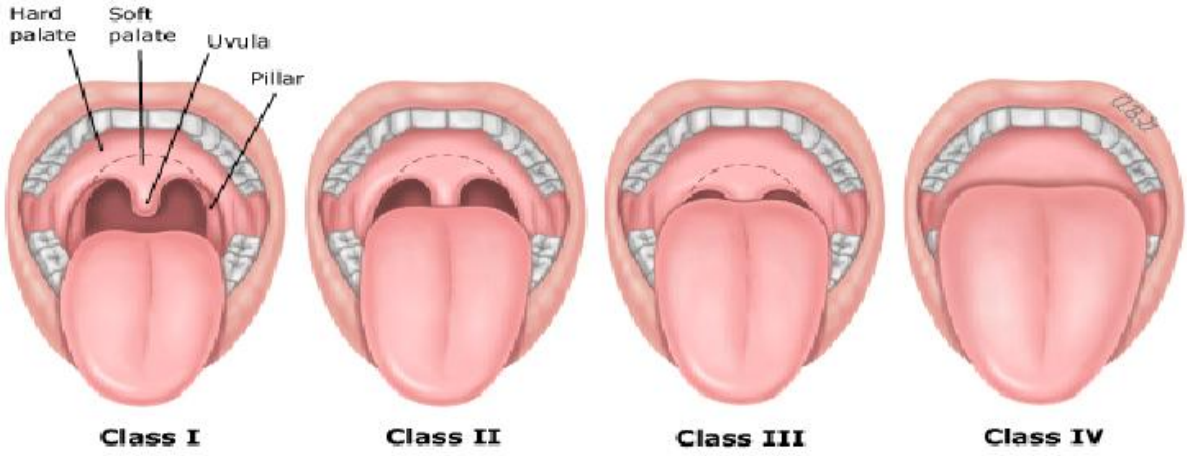


**Figure 1:** Modified Mallampati score.

**Clinical Significance of Mallampati Score:**

Mallampati score, proposed in the 1980s, is the most commonly employed tool for preoperative airway assessment. Both III and IV scores predict difficult intubation, but the predictive ability of the Mallampati score is poor, with sensitivity of 0.51 and specificity of 0.87. Other factors predicting difficult intubation are neck size (>40 cm), restricted neck movement, mouth opening of less than 3 finger breadths, thyromental distance of less than 6 cm, restricted mandibular protrusion, history of difficult intubation, obese individuals, age greater than 55 years, male gender, toothless individuals, beard, and history of

OSA/Snoring. Ventilation with the mask may also not be successful, and predicting this with the Mallampati score is not adequate. Pregnancy increases the Mallampati score due to edematous changes, and higher scores are associated with OSA/Snoring [15].

**Thyromental Distance (TMD):**

TMD is the straight-line distance from the thyroid cartilage to the mentum with full head extension, which is a prediction of difficult intubation. A reduced TMD indicates less room for laryngoscope manipulation, thereby increasing the difficulty of intubation. Any distance >6.5 cm is rarely difficult, whereas distances of 6–6.5 cm may present difficulties, and <6 cm makes it extremely difficult or impossible for direct laryngoscopy. TMD is a simple, practical method for guiding the approach to the difficult airway [16].

**Figure 2:** The measurement of the thyromental distance [17].

**Measuring thyromental distance:**

Predicting intubation challenges is possible with the help of thyromental distance (TMD), an important anatomical parameter. Different procedures, from traditional clinical methods to cutting-edge radiological ones, have been used to diagnose TMD over the years [18].

**1. Clinical Ruler Method:**

This method has been used for a long time and has widespread acceptance. The person is lying on their back, neck and head all the way out. The distance between the thyroid notch and the menton is measured with the mouth closed and a straight ruler (lower border of the mandible). Accuracy is of the utmost importance; thus the ruler is held firmly in place to prevent any sideways movement. This yields a quantifiable evaluation of TMD, typically reported in millimeters [19].

**2. Three Large Finger Breadths Method:**

This method is useful for a quick assessment at the bedside by using the clinician's fingertips as a makeshift ruler. The distance between the thyroid notch and the menton is measured by the clinician while the patient's head is held in a neutral position. The average TMD is around 6 cm, which is about the width of three huge fingers. While convenient, this method can be inaccurate depending on the examiner's hand size [20].

**3. Radiological Measurement:**

It should be noted here that the diagnostic accuracy of modern medical imaging techniques in this case is extremely high. With X-ray and MRI scans, doctors are actually able to visualize the side of a patient’s neck. After this, the image is used to calculate precisely how far apart the thyroid cartilage and menton are. Not only does this provide a precise measurement, it also gives a detailed view of the structure of the airway, which can be very useful in certain therapeutic situations. However, factors such as radiation

risks in X-ray scans, availability of resources, and time constraints could impact this approach in various ways [21].

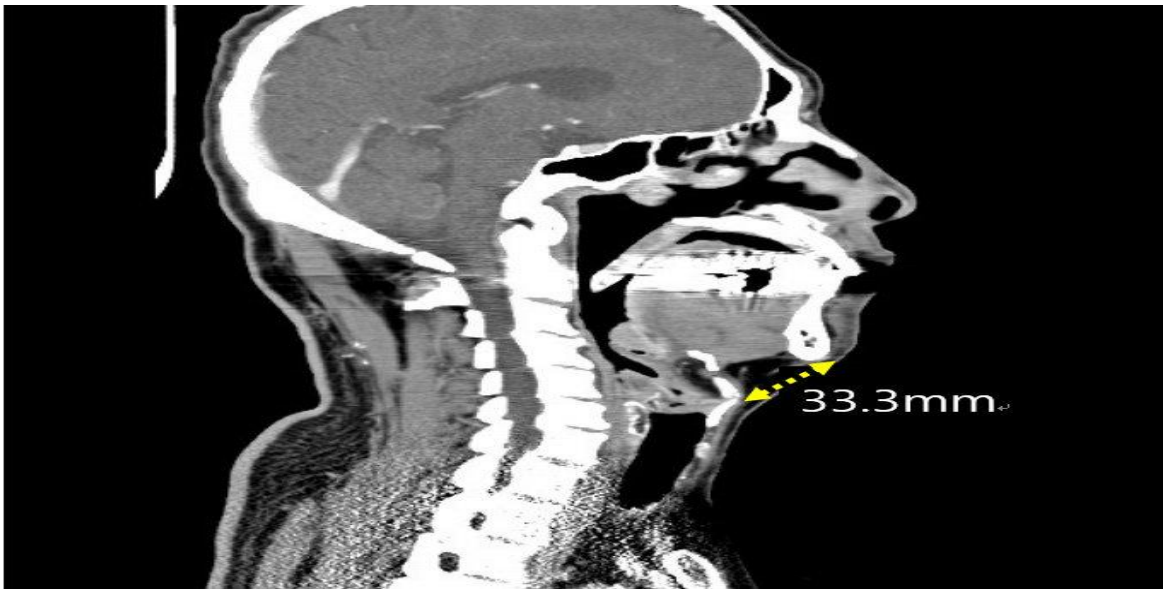


**Figure 3:** The patient showed a thyromental distance of 3.3 cm. A short thyromental distance (< 6 cm) is associated with difficult intubation [22].

**Thyromental distance predictive value**

TMD has been helpful, but it is still important to learn about its sensitivity and specificity. Although a TMD of less than 6 cm is an indicator of a potentially challenging airway, not all patients with such a small TMD will require intubation. Some people with a TMD larger than 6 cm, on the other hand, may still provide unexpected challenges [23].

Many anesthesiologists employ TMD in conjunction with the Mallampati score, neck mobility, and the Cormack and Lehane grading during laryngoscopy because of the limitations of TMD alone. By taking into account multiple variables, this method of evaluating airways can reduce the likelihood of complications [24].

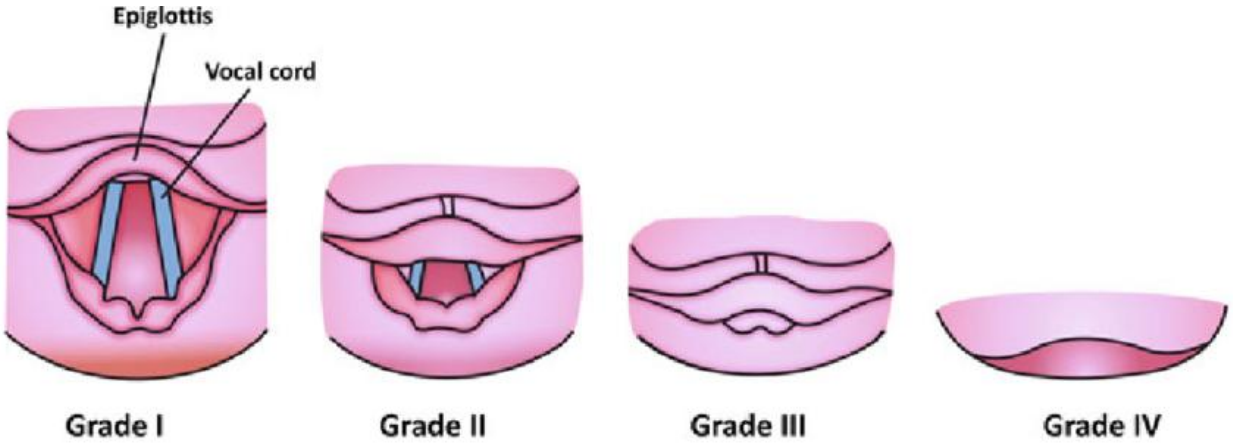


**Figure 4:** Cormack–Lehane system [25].

**Importance of Correlating Mallampati Score, Thyromental Distance, AND Score in Obese Patients:**

**1. Obesity and Airway Management:**

The structure and function of the airway are both affected by obesity. Changes that may not be picked up by standard methods of evaluation may occur as a result of fat depositing around the throat and neck. As a result, it is essential in these individuals to grasp the interplay between different assessment scores [26].

**2. Comprehensive Airway Assessment:**

The patient's airway can be evaluated in different ways using the Mallampati, Thyromental Distance, and Cormack and Lehane scores. When taken separately, they could miss important details. To make sure no part of the airway is missed, a correlated method gives a comprehensive evaluation [27].

**3. Gaps in Current Literature:**

Despite the widespread nature of obesity, there is a paucity of research that integrates all these scores, and this is especially true for the obese population. Few studies consider multiple scores simultaneously, reducing their relevance to actual clinical practice [28].

**4. Clinical Application and Patient Safety:**

An robust correlation can help anesthesiologists and surgeons plan ahead for challenging intubations. When people have advance notice, they can better prepare for any airway-related issues that may arise [29].

## PATIENT AND METHOD:

**1. Study type and setting:**

A cohort study conducted at Al-Imamin Al-Kazemin Medical City - Department of Anesthesia.

**Patients:**

A total 60 number of patients were enrolled in the study.

**Inclusion criteria:**

- Obesity: Define as BMI ≥ 30 kg/m².
- Age Range: adults aged 18-55 years.
- Elective surgery

**Exclusion criteria**

- Pre-existing Airway Abnormalities: patients with known airway deformities or previous airway surgeries, as these could skew the results.
- Severe Respiratory Diseases: Patients with advanced respiratory diseases like severe COPD or asthma might have altered airway anatomy or function.
- Critical Illness or Trauma: Patients in critical condition or with recent facial or neck trauma may not be suitable for standard airway evaluation.
- Goitre
- Facial burn
- Radiation.

**2. Data collection:**

**Demographic and Baseline Data Collection**

**Basic Information:** Age, gender, and BMI (Body Mass Index).

**Medical History:** Detailed records of each patient's medical history, focusing on aspects related to respiratory function, previous surgeries, and past airway management experiences, were compiled.

**Airway Assessment**

**1- Mallampati Score:**

**Procedure:** Conducted with the patient sitting upright. The patient opened their mouth and extended their tongue without phonation.

**Scoring:** Based on the visibility of the oropharyngeal structures.

Grades:

**Class I:** Soft palate, fauces, uvula, and pillars visible.

**Class II:** Soft palate, fauces, and uvula visible.

**Class III:** Soft palate and the base of the uvula visible.

**Class IV:** Only the hard palate visible.

**2- Thyromental Distance:**

**Measurement:** Conducted with the head extended and the neck fully stretched. The distance from the thyroid notch to the chin tip in a straight line was measured.

**Defining Difficult Intubation**

**Difficult Intubation According to Cormack and Lehane Score:** Typically, a difficult intubation is defined when a Cormack and Lehane score of Grade III or IV is observed, indicating limited or no visibility of the glottis.

**General Anesthesia Administration**

1. **Preoperative Assessment**: Prior to the induction of anesthesia, a detailed preoperative assessment was performed. This included the evaluation of the Mallampati score, thyromental distance, and other relevant factors to assess the risk of difficult airway in each obese patient. And capnograph monitoring was done.
2. **Preparation for Induction**: Standard monitoring devices were attached to the patient, including ECG, non-invasive blood pressure cuff, and pulse oximetry. Intravenous access was established.
3. **Induction of Anesthesia**: Anesthesia was induced using a combination of ketamine 0.1-0.5 mg/kg, propofol 1.5-2.5 mg/kg, and rocuronium 0.6 mg/kg. The doses were adjusted according to the patient's weight and individual response. Ketamine was administered first for its analgesic properties. Additional doses of intravenous medications (fentanyl 0.5-1 mcg/kg) as required. Propofol followed to induce a state of unconsciousness, and rocuronium was used to achieve muscle relaxation. Midazolam 10-100 micg/kg also used as needed.
4. **Maintenance of Anesthesia**: Anesthesia was maintained with a balanced technique using inhalational agents (sevoflurane 2 MAC), titrated to the depth of anesthesia and patient’s physiological responses.

**3. Management of Difficult Airway**

1. **Anticipation and Preparation**: Given the high incidence of difficult airway in obese patients, equipment for managing difficult intubation, such as a stylet and bougie, was kept readily available.
2. **Intubation Technique**: Standard laryngoscopy was initially attempted after general anesthesia induction. The Cormack and Lehane scoring system was used to grade the laryngeal view during intubation.
3. **Difficult Airway Management**: In cases where a difficult airway was encountered (Cormack and Lehane Grade III or IV), a second or third trial of intubation with the use of video laryngoscopy, or the use of stylet to guide the endotracheal tube into the trachea. If unsuccessful, the intubation would attempt using a bougie as a guide under direct laryngoscopy. In case of inability to intubate, sugamdex 16 mg/kg would be used for reversal of muscle relaxant and abortion of the procedure.

4. **Confirmation of Intubation**: Proper placement of the endotracheal tube was confirmed by end-tidal CO2 waveform and bilateral chest auscultation.
5. **Documentation**: Detailed documentation of the airway assessment, intubation technique, number of attempts done, and any difficulties encountered was made in the patient's anesthesia record.

**4. Outcome**

The primary outcome is to estimate the number of difficult intubation cases, while the secondary outcome is to estimate the number of trial of intubations, and the need for other devices for intubation.

**Ethical considerations**

Before beginning the investigation, permission was obtained from the scientific committee at Al-Imamin Al-Kazemin Medical City hospital.

Patients gave their verbal agreement after being informed of the study's goal and assured that their information would be kept confidential and used exclusively for research.

**Statistical analysis**

The information was entered into Microsoft Excel sheet 16, and then transferred to IBM SPSS V26 for statistical analysis.

Tables including descriptive statistics (number and frequency, averages and standard deviations), estimates of statistical significance (Chi square and fisher exact), and tests of statistical significance (Student t text and Mann-Whitey U test) for categorical and non-parametric data, respectively.

The threshold for statistical significance was set at a P value equal to 0.05.

**Results and Discussion**

The total number of cases included in the current study was 60 cases, the intubation difficulty was categorized into two groups Difficult (CLS grade III and IV) and Easy (CLS grade I and II). Out of the total patients assessed, 17 were classified as having Difficult intubations, which constituted 28.3% of the patients. Conversely, 43 patients were classified under Easy intubations, making up 71.7% of the study group. These findings indicate a significant proportion of patients experiencing difficult intubation scenarios in the studied population, as shown in Figure .

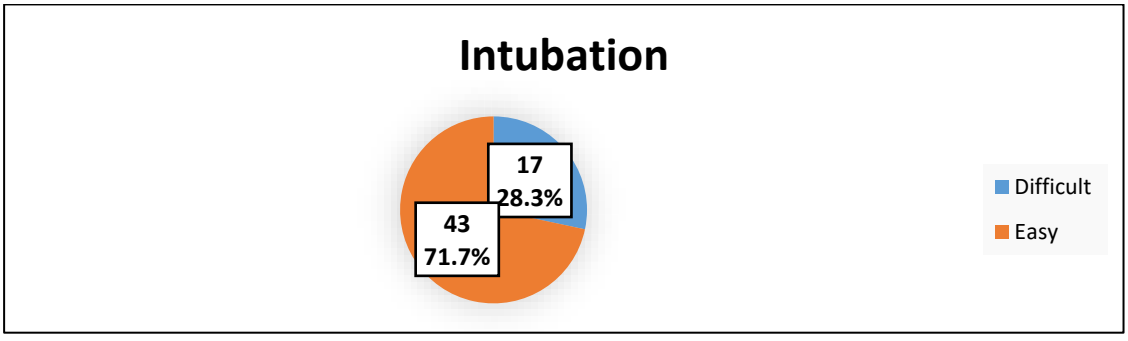


**Figure 5:** Distribution of the cases according to difficulty of intubation.

Regarding Body Mass Index (BMI), patients in the difficult intubation group had an average BMI of 37.09 kg/m² with a standard deviation of 1.18, compared to the easy intubation group, which had an average BMI of 34.74 kg/m² with a standard deviation of 1.55. The P value for BMI was 0.001, suggesting a statistically significant difference

between the two groups, with higher BMI associated with increased difficulty in intubation, as shown in table 3-1

**Table 4.** Distribution of the BMI according to the difficulty of the intubation.

| Variables | Difficult n=17 | Easy n=43 | P value |
|---|---|---|---|
| | Mean ±SD | Mean ±SD | |
| BMI (kg/m²) | 37.09 ±1.18 | 34.74 ±1.55 | 0.001 |
| | | | |

**Table 5.** Mallampati score and thyromental distance distribution according to the grade of Cromack Lehane **score.**

| Variables | | Cormack and Lehane Score | | | | P value |
|---|---|---|---|---|---|---|
| | | Grade I | Grade II | Grade III | Grade IV | |
| Mallampati Score | Grade I | 16 (51.6) | 7 (58.3) | 2 (28.6) | 0 (0) | <0.0001 |
| | Grade II | 10 (32.3) | 3 (25) | 2 (28.6) | 0 (0) | |
| | Grade III | 3 (9.7) | 2 (16.7) | 3 (42.9) | 6 (60) | |
| | Grade IV | 2 (6.5) | 0 (0) | 0 (0) | 4 (40) | |
| Thyromental Distance (cm) | | 7.34 ±0.66 | 7.48 ±0.7 | 6.31 ±0.65 | 5.87 ±0.54 | <0.0001 |

A critical aspect of our study was to evaluate the relationship between the number of intubation attempts and various predictors of airway difficulty, namely the Cormack and Lehane score, the Mallampati score, and the thyromental distance. These findings are illustrated in

The data for Cormack and Lehane Scores across the sampled population is as follows: Grade I: 31 individuals were observed with a Grade I score, which represents 51.7% of the participants. Grade II: 12 individuals were classified as Grade II, accounting for 20.0% of the total. Grade III: The score for Grade III was given to 7 individuals, constituting 11.7% of the sample. Grade IV: Lastly, 10 individuals received a Grade IV score, making up 16.7% of the participants [30].

These percentages reflect the distribution of the Cormack and Lehane Scores within the study population, indicating that over half of the individuals had a full view of the glottis (Grade I), which is generally associated with easier intubation, as shown in Figure

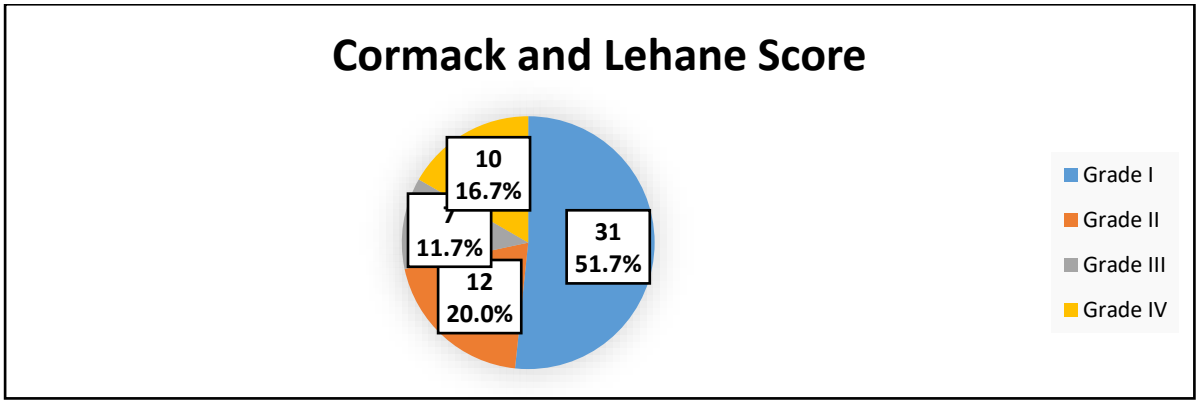


**Figure 6:** Distribution of the cases according to Cormack and Lehane Score.

The airway management process becomes difficult in obese patients because their body structure and bodily functions create conditions which lead to higher chances of experiencing intubation difficulties. Medical personnel must identify patients who face risks because these patients require special care to prevent dangerous medical situations which include hypoxia and trauma and extended periods of anesthesia. The combination of Mallampati score and thyromental distance (TMD) serves as an effective preoperative assessment tool which predicts challenging intubation cases with its straightforward testing method. The analysis discovered important links between Mallampati score and TMD and Cormack and Lehane (C&L) grades which scientists use to show laryngoscopic view during the intubation process. The study found that patients with higher Mallampati scores (III and IV) experienced more difficult C&L grade visualizations. The study showed that patients with Mallampati IV scores did not achieve C&L grades I or II which proves the score works well to detect patients who have high-risk status [31].

Thyromental distance showed an inverse relationship with the level of difficulty experienced during intubation procedures. Patients with shorter TMDs faced a higher chance of having C&L grade advancement which required them to undergo multiple intubation attempts. The study showed that C&L Grade IV patients had the shortest average TMD because their distance between the thyroid notch and mental protuberance measured shorter thus restricting the space needed for mandibular movement which hinders glottic exposure. The parameters of the study affected the number of intubation attempts which took place during the research. Patients who held Mallampati scores which fell between I and II needed fewer intubation attempts than their counterparts with scores from III and IV who needed two or more attempts ($P = 0.006$). The study found that patients with shorter TMDs faced more complex intubation challenges because they needed adjunct devices like stylets or bougies to achieve successful tube placement ($P = 0.002$). The study discovered that patients with higher C&L grades had an increase in intubation attempts because all Grade IV patients required three attempts ($P < 0.0001$). The research shows that Mallampati score and thyromental distance serve as effective predictors for identifying difficult intubation cases which occur in obese patients. The parameters create an effective method for anesthesiologists to handle airway complications because they help in forecasting potential difficulties which need alternative airway devices and specific patient positioning and specialized equipment for airway management.

Clinical Implications the Mallampati score and TMD assessment method can assist healthcare professionals to provide safer surgery procedures because it helps them find patients who face potential surgical problems. The bedside measurements enable anesthesiologists to assess patients for the likelihood of difficult intubation thus determining the proper sequence of operational steps to follow. The worldwide rise in obesity together with its related airway problems requires medical facilities to adopt predictive tools as standard practice because these tools will help decrease patient complications during surgical procedures and lead to better medical results. The study shows that Mallampati score and thyromental distance can successfully predict difficult intubation for obese patients because they relate to both Cormack and Lehane grading and the number of intubation attempts. Medical institutions should adopt these assessment tools as standard procedures to evaluate airway conditions before surgery for patients with obesity.

**Table 6.** Number of intubation attempts according to the scoring system of difficulty.

| **Predictor** | | **Number of Intubation Attempts** | | | |
|---|---|---|---|---|---|
| | | **One** | **Two** | **Three** | **P value** |
| | | **No. (%)** | **No. (%)** | **No. (%)** | |
| **Mallampati score** | **I** | 23 (52.3) | 2 (18.2) | 0 (0) | **0.006** |

| | | | | | |
|---|---|---|---|---|---|
| | **II** | 9 (20.5) | 6 (54.5) | 0 (0) | |
| | **III** | 9 (20.5) | 2 (18.2) | 3 (60) | |
| | **IV** | 3 (6.8) | 1 (9.1) | 2 (40) | |
| **Thyromental Distance (cm)** | **Mean ±SD** | 7.2 ±0.77 | 6.71 ±0.95 | 5.88 ±0.76 | **0.002** |

Intubation difficulty is a major concern among obese patients because of their anatomical differences, fat deposition, and limited neck mobility. Preoperative intubation difficulty can be predicted to ensure that appropriate strategies and equipment can be used to make intubation less challenging. The Mallampati score and Thyromental distance are commonly used anatomical parameters to predict intubation difficulty.

**Predictive Value of Mallampati Score:**

A high Mallampati score is associated with the difficulty of intubation. Patients with a Mallampati score of I are usually intubated without the use of additional devices. However, scores III and IV require the use of stylets or bougies. Mallampati Score has a sensitivity of 76.47% and specificity of 83.72% for the prediction of difficult intubation. It has a high negative predictive value of 90%. Thus, it is reliable for the prediction of difficult intubation.

**Predictive Value of Thyromental Distance:**

A shorter thyromental distance is associated with the difficulty of intubation. Patients requiring additional devices for intubation had progressively shorter thyromental distances. Patients requiring no additional devices had a mean thyromental distance of 7.24 cm, whereas the stylet was at a mean thyromental distance of 6.62 cm, and the bougie was at a mean thyromental distance of 5.82 cm. TMD has a sensitivity of 58.82% and specificity of 88.37%. It has an accuracy of 80%. Thus, it is a reliable predictor for the identification of difficult intubation cases.

**Correlation with Device Usage:**

Mallampati score and thyromental distance correlate significantly with the use of additional devices for the purpose of intubation. A high Mallampati score and a low thyromental distance predict the use of additional devices for the purpose of intubation. Thus, the Mallampati score and thyromental distance are effective predictors for difficult intubation. They are effective predictors for difficult intubation in the case of obese patients.

**Table 7.** Use of other assisting devices for intubation.

| **Predictor** | | **Other Devices Used for Intubation** | | | |
|---|---|---|---|---|---|
| | | **None** | **Stylet** | **Bougie** | **P value** |
| | | **No. (%)** | **No. (%)** | **No. (%)** | |
| **Cormack and Lehane score** | **I** | 29 (64.4) | 2 (22.2) | 0 (0) | **<0.0001** |
| | **II** | 12 (26.7) | 0 (0) | 0 (0) | |
| | **III** | 4 (8.9) | 2 (22.2) | 1 (16.7) | |
| | **IV** | 0 (0) | 5 (55.6) | 5 (83.3) | |
| **Mallampati score** | **I** | 25 (55.6) | 0 (0) | 0 (0) | **0.001** |
| | **II** | 11 (24.4) | 4 (44.4) | 0 (0) | |
| | **III** | 7 (15.6) | 3 (33.3) | 4 (66.7) | |
| | **IV** | 2 (4.4) | 2 (22.2) | 2 (33.3) | |

| | | | | | |
|---|---|---|---|---|---|
| **Thyromental Distance (cm)** | **Mean ±SD** | 7.24 ±0.78 | 6.62 ±0.8 | 5.82 ±0.66 | **<0.0001** |

Receiver Operating Characteristic Curve Analysis using the ROC curve showed that the p-value <0.0001 in this context means that Thyromental Distance is not only significantly different from chance but is also a reliable indicator in differentiating between difficult and easy intubation cases. The AUC value is 0.912, showing a high level of accuracy in the test results. AUC is part of the ROC curve analysis that ranges from 0 to 1. An AUC value of 1 means perfect test performance, while an AUC value of 0.5 means no test performance at all [31]

An AUC value of .912 means that the Thyromental Distance has a very high probability of correctly classifying a case as either difficult or easy in terms of intubation. Cutoff Point or ≤6.5 cm is a specific value used to differentiate between a positive or negative test result. In this case, the Thyromental Distance value of 6.5 cm or less is used as a predictor for difficult intubation. The selection of the cutoff point is important as it balances sensitivity and specificity to optimize test performance. The cutoff point was allocated based on the Yoden J Index test to select the best cutoff point, which is 6.5 cm or less as a predictor for difficult intubation, as shown in Figure

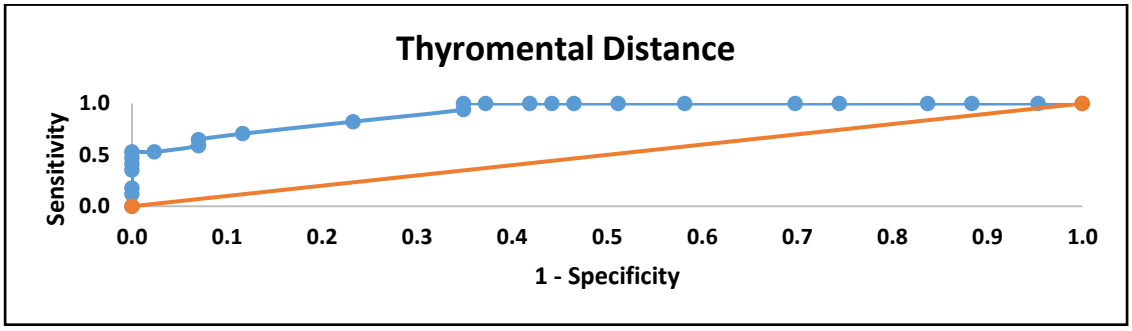


**Figure 7:** Receiver Operating Characteristic curve for Thyromental Distance in prediction of difficult intubation.

The evaluation process to determine airway challenges in obese patients plays a critical role in safe anesthetic procedures because obesity leads to a higher probability of experiencing difficult intubation. The predictive tools for assessing airway difficulties use Thyromental Distance (TMD) and Mallampati Score as their standard assessment methods. The study results showed Thyromental Distance achieved 58.82% sensitivity because it diagnosed about 59% of difficult intubation instances. The test identified patients who could be easily intubated with 88.37% accuracy. The Positive Predictive Value (PPV) which stands at 66.67% indicates that TMD predicts a difficult airway correctly two times out of three instances, whereas the Negative Predictive Value (NPV) which stands at 84.44% shows that doctors can predict easy cases most of the time. The overall predictive accuracy of TMD reached 80% with an Odds Ratio (OR) of 10.86 which demonstrated a strong link to difficult intubation events [32][33][34][35].

This test showed higher sensitivity when it recorded 76.47%, which confirmed the ability of the test to identify difficult intubations more accurately than other methods. The test showed a specificity of 83.72%, which enabled the test to identify most patients with easy intubations. The PPV of the test showed 65%, and the NPV showed 90%. This confirmed the ability of the Mallampati Score to accurately eliminate difficult intubations, with an overall accuracy of 81.67%. The Odds Ratio showed 16.71, which confirmed the ability of the test to predict difficult intubations more accurately than TMD.

Results of the study showed that the Thyromental Distance provides higher specificity than the Mallampati Score, which provides higher sensitivity and NPV, thus confirming the ability of the two tests to work together to assess obese patients who might experience difficulties during intubation.

**Table 8:** Predictive ability of Thyromental Distance and Mallampati Score in prediction of difficult intubation.

| Parameter | Thyromental Distance | Mallampati Score | Combined |
|---|---|---|---|
| **Sensitivity** | 58.82% | 76.47% | 58.8% |
| **Specificity** | 88.37% | 83.72% | 97.7% |
| **Positive predictive value** | 66.67% | 65% | 90.9% |
| **Negative predictive value** | 84.44% | 90% | 85.7% |
| **Accuracy** | 80% | 81.67% | 70% |
| **Odd ratio** | 10.86 | 16.71 | 25.2 |

**Discussion:**

Anesthesiologists find it extremely difficult to manage airway problems in obese patients who have higher chances of experiencing difficult intubation which leads to increased patient suffering and death during surgery. Obesity alters airway anatomy through increased neck circumference and deposition of adipose tissue and reduced mandibular space, which makes it difficult to see the glottis when performing laryngoscopy. Accurate airway difficulty prediction enables healthcare providers to improve patient safety while enabling organizations to prepare more effectively, which leads to better intubation success rates. This study evaluated 60 obese patients who had a body mass index of 30 kg per square meter to assess whether the Mallampati score and thyromental distance TMD could predict difficult intubation. The researchers used the Cormack and Lehane C&L grading system to assess difficult intubation by classifying the glottic view obtained during laryngoscopy. The results showed that 28.3% of patients experienced difficult intubation according to C&L grading.

It was analyzed that with increased scores of III and IV, the chances of encountering difficulties during intubation increased. The Mallampati score had a sensitivity of 76.47%, specificity of 83.72%, positive predictive value of 65%, and negative predictive value of 90%. The Mallampati score acts as an excellent predictor to identify patients who encounter straightforward intubation processes, but when used independently to identify patients with challenging intubation processes, the score shows poor performance. Thyromental distance of 6.5 cm or less was associated with difficulties during intubation because of the score's 58.82% sensitivity and 88.37% specificity and 66.67% positive predictive value and 84.44% negative predictive value. The Mallampati score was less sensitive to predicting intubation difficulties compared to TMD but acts as a specific predictor to identify patients with intubation difficulties when the distance is more than 6.5 cm [33-35].

The combination of both parameters—Mallampati score and thyromental distance—resulted in better predictive accuracy than using each parameter independently. The combined assessment achieved a PPV of 90.9% which showed that the dual evaluation method offers better prediction accuracy for difficult intubation in obese patients than using either test individually. The airway assessment procedure needs to be more comprehensive for this population because they have high-risk characteristics. Previous research demonstrated that BMI range and patient age and study population differences

caused changes in study results. The sensitivity and specificity of Mallampati and TMD tests show different results across studies but the combined assessment maintains higher predictive strength. Multiple anatomical assessments should be integrated into assessment procedures instead of using a single parameter to make decisions.

**Clinical Implications:**

- All obese patients should undergo preoperative evaluation through both Mallampati score and thyromental distance assessment.
- This dual assessment enables anesthesiologists to predict difficult airways while preparing for the necessary use of adjunct devices such as stylets and bougies, which helps them minimize the chances of intubation failure.
- Predictive tool implementation leads to both enhanced patient safety outcomes and better anesthetic performance results.

**Conclusion:**

Mallampati score and thyromental distance measurements indicate a strong correlation with the results of the Cormack-Lehane scores. These measurements were also a part of the research study that involved 60 obese patients. The research findings showed that a high Mallampati score and a reduced thyromental distance resulted in a significantly difficult intubation procedure for the obese patients. These parameters also help to a greater extent to predict difficult intubation by achieving a positive predictive value of 90.9%. The research findings also indicate the need to conduct a complete preoperative evaluation for obese patients to ensure a successful intubation procedure. Anesthesiologists can effectively plan the procedure by integrating the anatomical measurements with the results of the laryngoscopic grading. These measurements need to be evaluated with the expected results of the Cormack-Lehane grading to achieve a high level of patient safety for the obese patient.

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